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## Profiling OGSA-DAI Performance for Common Use Patterns

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# **Profiling OGSA-DAI Performance for Common Use Patterns**

UK e-Science  
All Hands Meeting 2006

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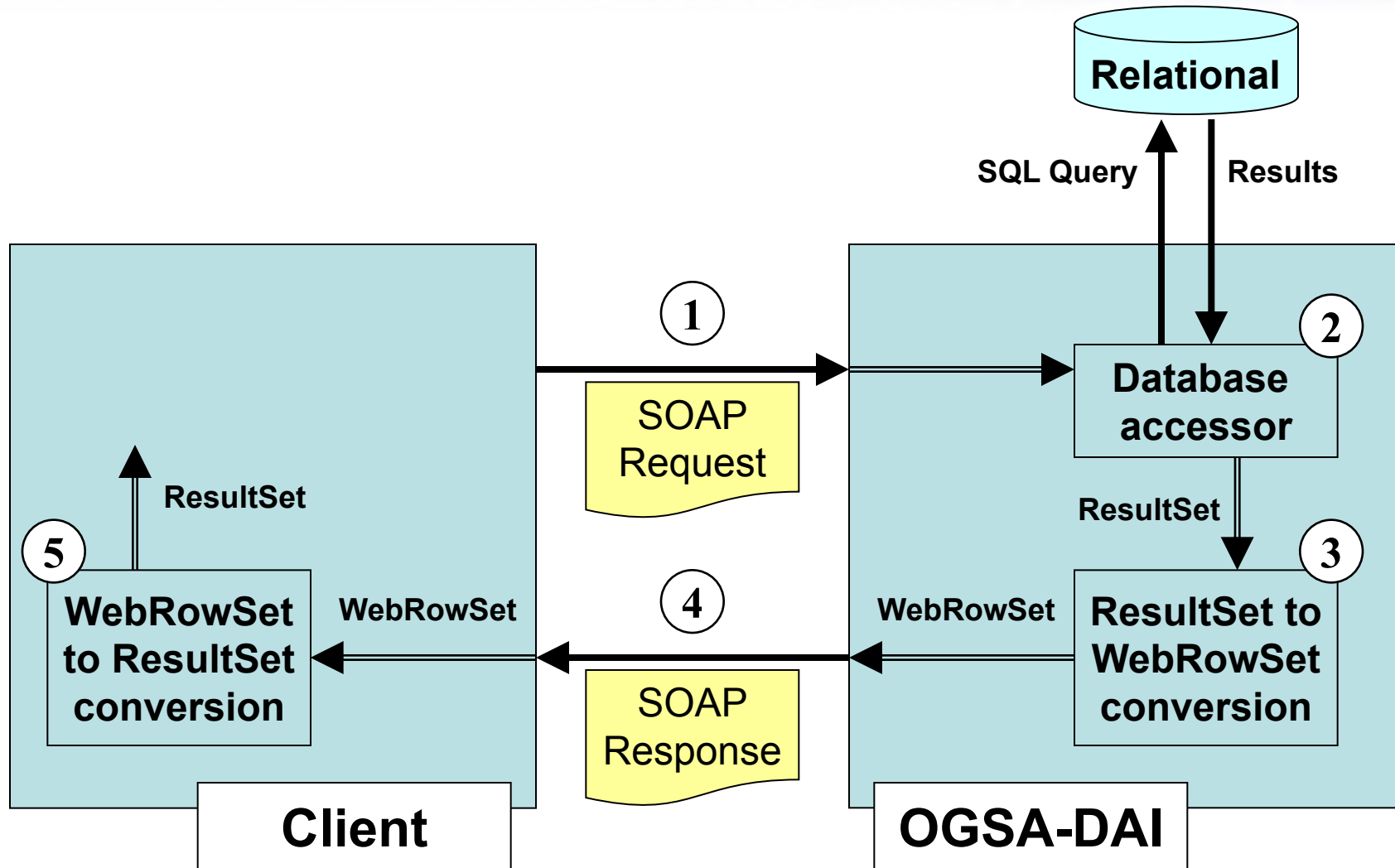
Bartosz Dobrzelecki  
EPCC, The University of Edinburgh

- Web Services interface to databases
- An *extensible framework* for data access and integration
- Expose heterogeneous data resources to a grid through web services
  - Relational
  - XML
  - File based
  - User provided (extensibility point)
- Interact with data resources
  - Queries and updates
  - Data transformation / compression
  - Data delivery
  - Application-specific functionality
- A base for higher-level services
  - Federation, mining, visualisation,...





- Have selected two typical use patterns
  - Use these as a basis for improving the performance
- First use pattern: SQL query
  - Client runs an SQL query on a remote OGSA-DAI service
  - OGSA-DAI service returns the query results to the client
  - Results are contained in an XML document
- Second use pattern: User accesses binary data
  - Binary data could be files or BLOBs in a database
  - Data is exposed by an OGSA-DAI service
  - Encoded data is delivered to a client in an XML document



## **Bottleneck:**

- Conversion between ResultSet (object) and WebRowSet (XML)
  - Large number of String to bytes conversions

## **Improvements:**

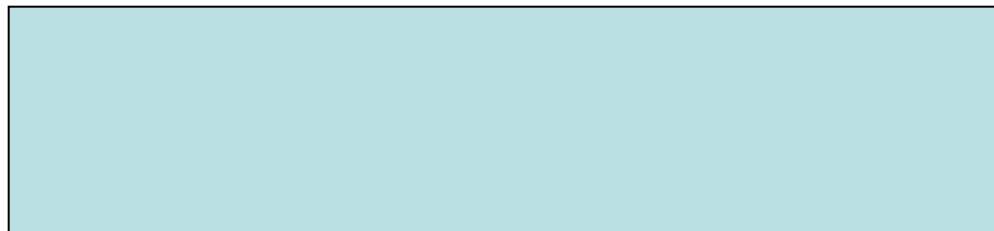
- Restricted conversion framework to text based formats only
  - Data represented internally as char sequence
- Improved the performance of XML production
  - To produce valid documents special XML characters need to be escaped
  - Previously used regular expressions Java API to do this
  - For large number of rows this process becomes very expensive
  - Have implemented a much more efficient parser to perform this task

## Bottleneck

- WebRowSet format is only used for intermediate delivery
  - Adds significant amount of mark-up to describe data
  - More data hence it affects message transfer times
  - XML is still expensive to parse

## Improvement

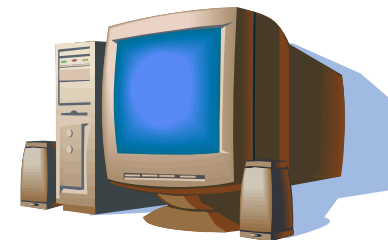
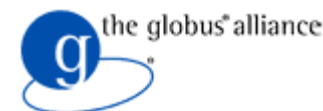
- Instead use CSV (Comma Separated Values) as an alternative
  - More lightweight
  - Easier to parse document format
- For example to represent one row:



## Drawbacks

- No metadata (optional line with column names)
  - Could be delivered in separate stream as WebRowSet metadata
- CSV is not standardised - used consistently within OGSA-DAI

- Container
  - Apache Tomcat 5.0.28
- Globus
  - Globus Toolkit WS-Core 4.0.1
- OGSA-DAI
  - OGSA-DAI WSRF v2.1
  - OGSA-DAI WSRF v2.2
- Machines
  - Server
    - Sun Fire V240 with dual 1.5GHz UltraSPARC IIIi and 8GB RAM
    - Solaris 10 and J2SE 1.4.2\_05
  - Client
    - Dual 2.4GHz Intel Xeon system with
    - RedHat 9 Linux and J2SE 1.4.2\_08





## JVM flags

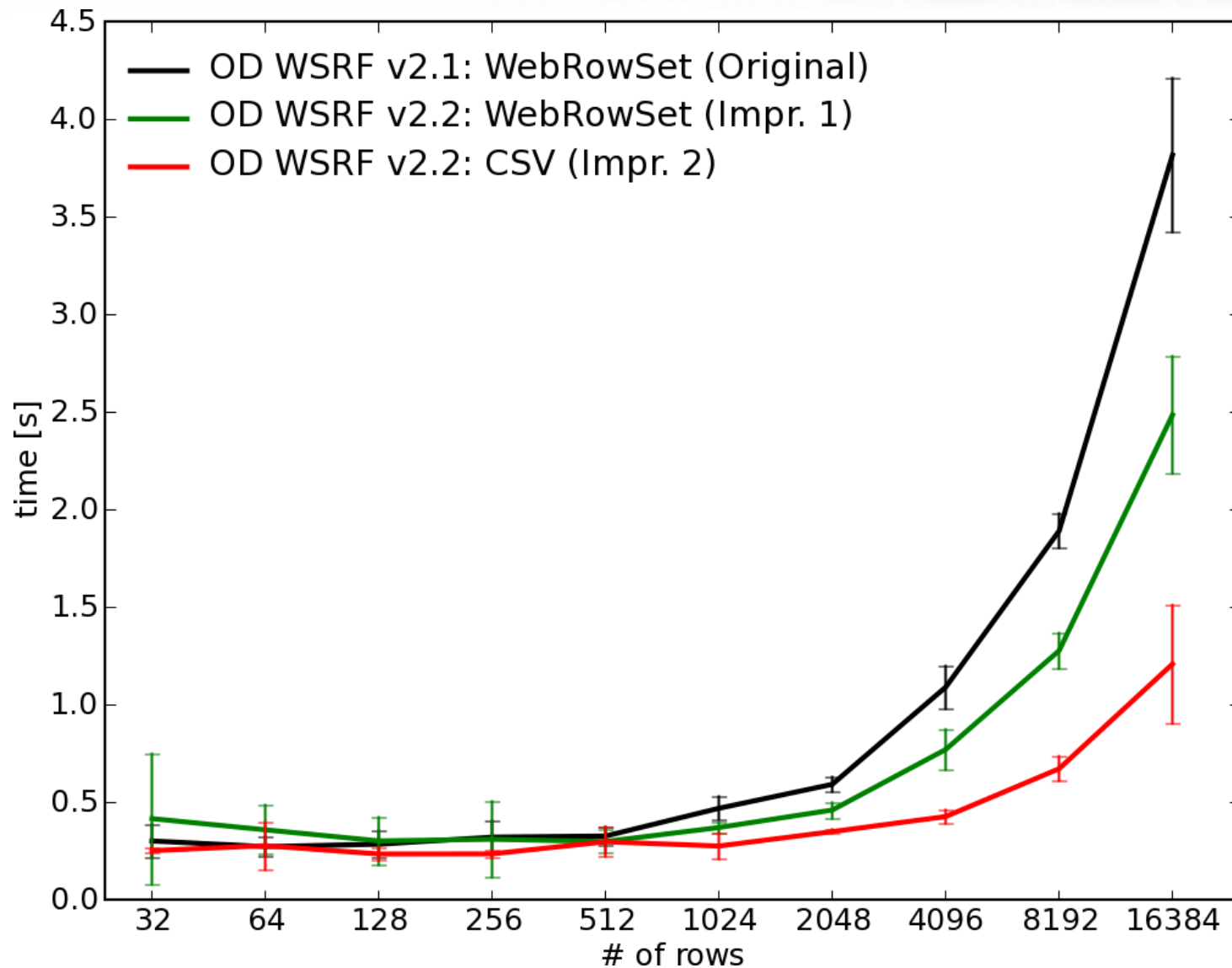
- `-server -Xms256m -Xmx256m`

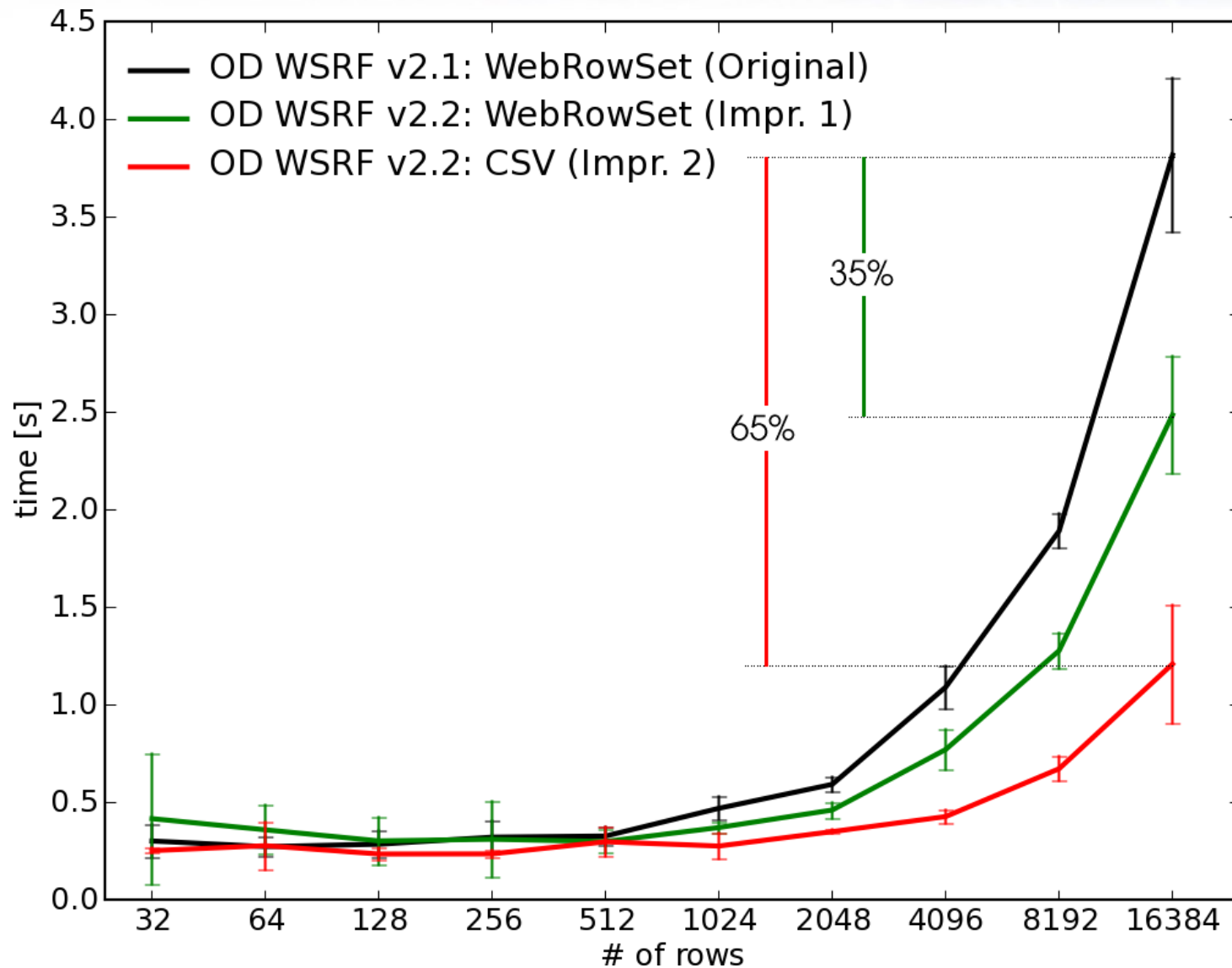
## Network

- LAN network packets traversed two routers.
  - Average network bandwidth 94 Mbits/s
  - Average round-trip latency <1 ms

## Database

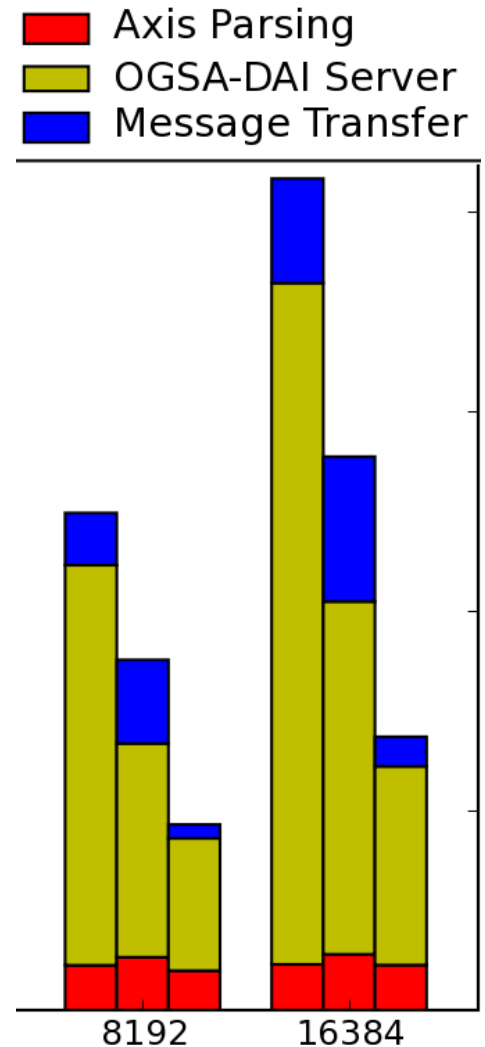
- MySQL 5.0.15
  - MySQL Connector/J ver. 3.1.10
  - Mean table row length (text) used in experiments was 66 bytes
- JVMs were warmed up before taking measurements.
- Results reported are the average of these runs
- Error bars indicating +/- standard deviation



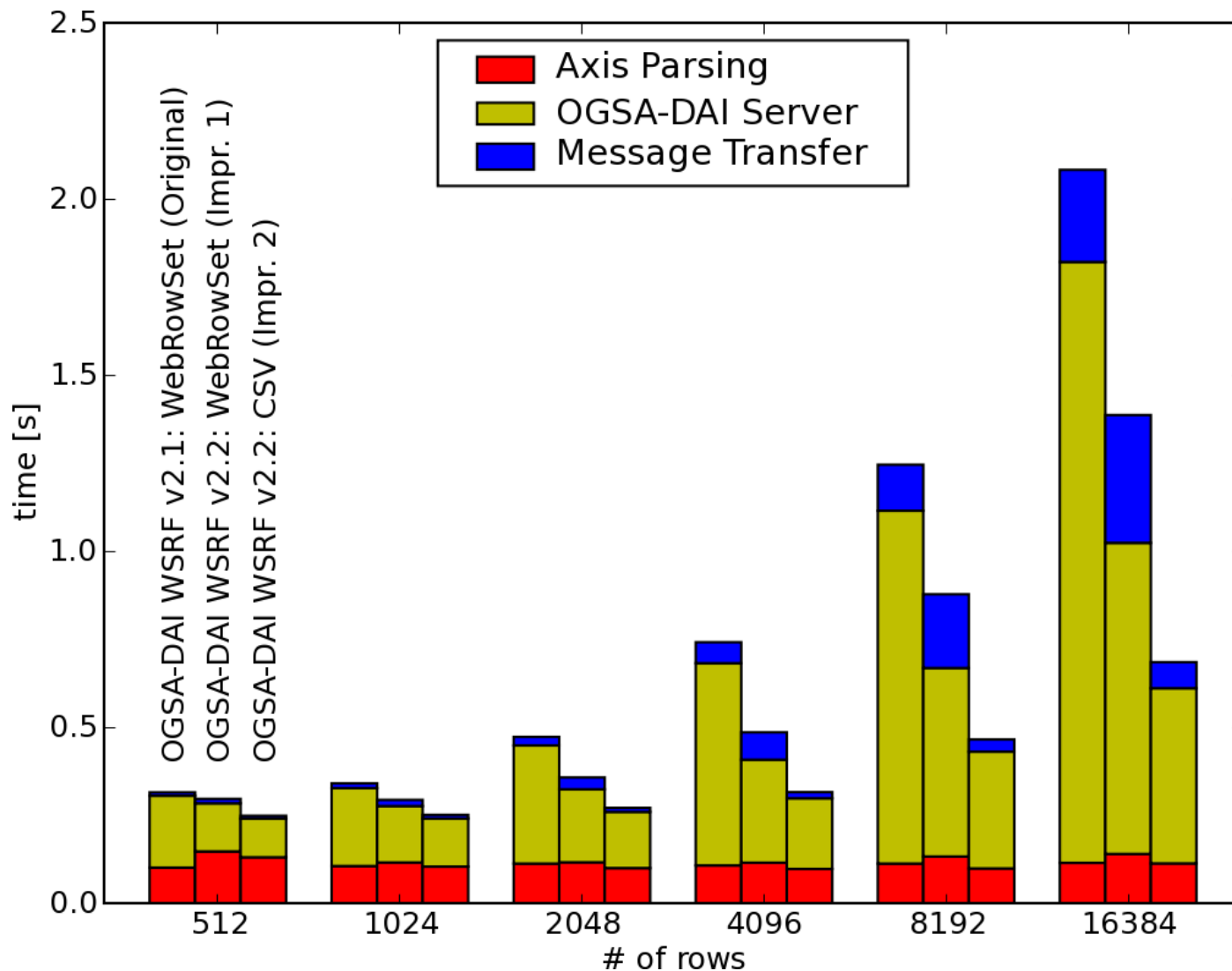


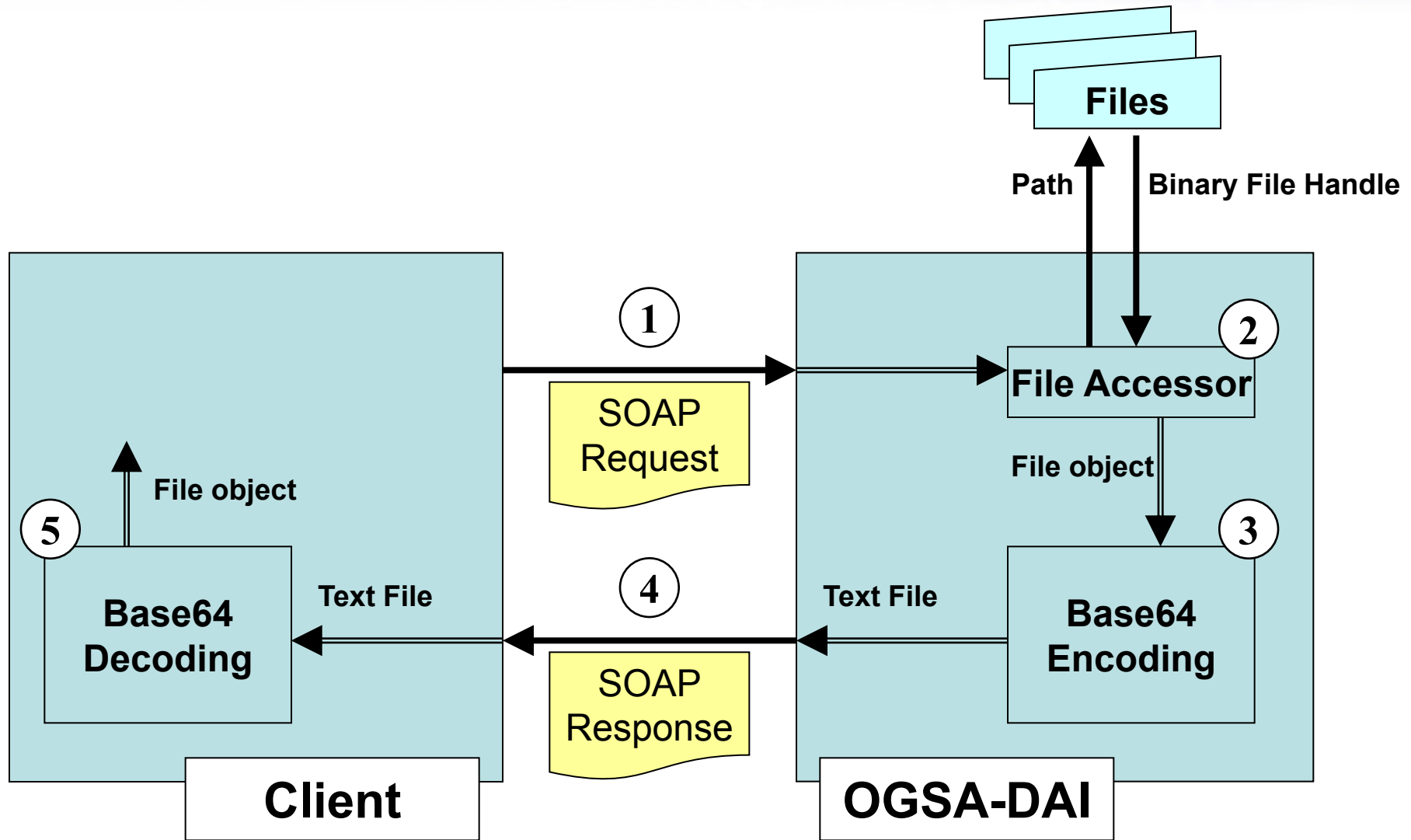
- Used Apache Axis  
`org.apache.axis.TIME` log category
- Records the time to execute incoming message
- Axis splits time into preamble, invoke, post and send phases
- In our plots

Axis Parsing = preamble  
OGSA-DAI Server = invoke  
Message Transfer = post + send









## **Bottleneck**

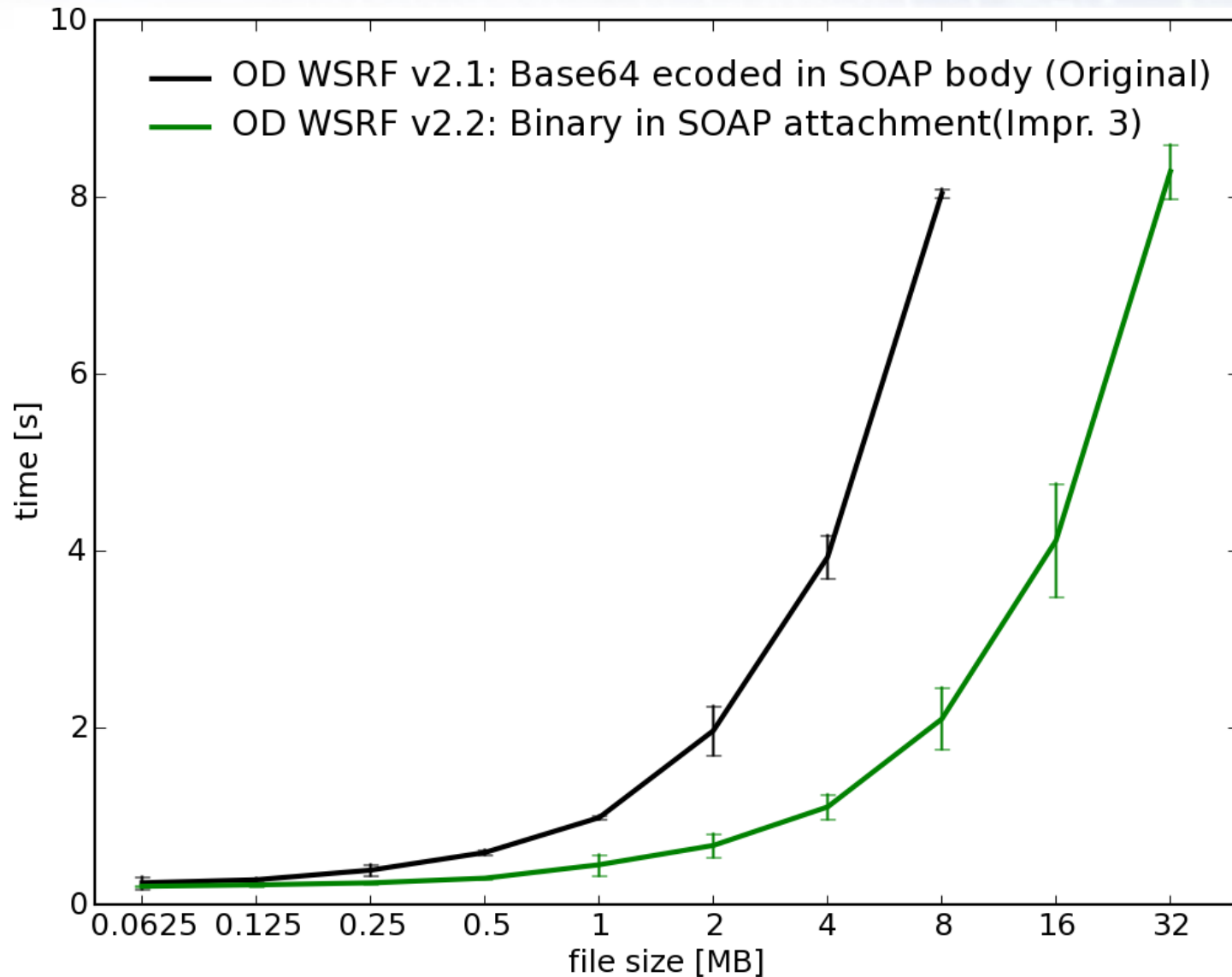
- Binary data needs to be Base64 encoded
  - Necessary to be included in a SOAP message
- Encoding and decoding requires additional computation
- The size of a data to be transferred grows by approximately 35%.
  - Base64 encoding uses 4 ASCII characters to represent 3 bytes

## **Improvement**

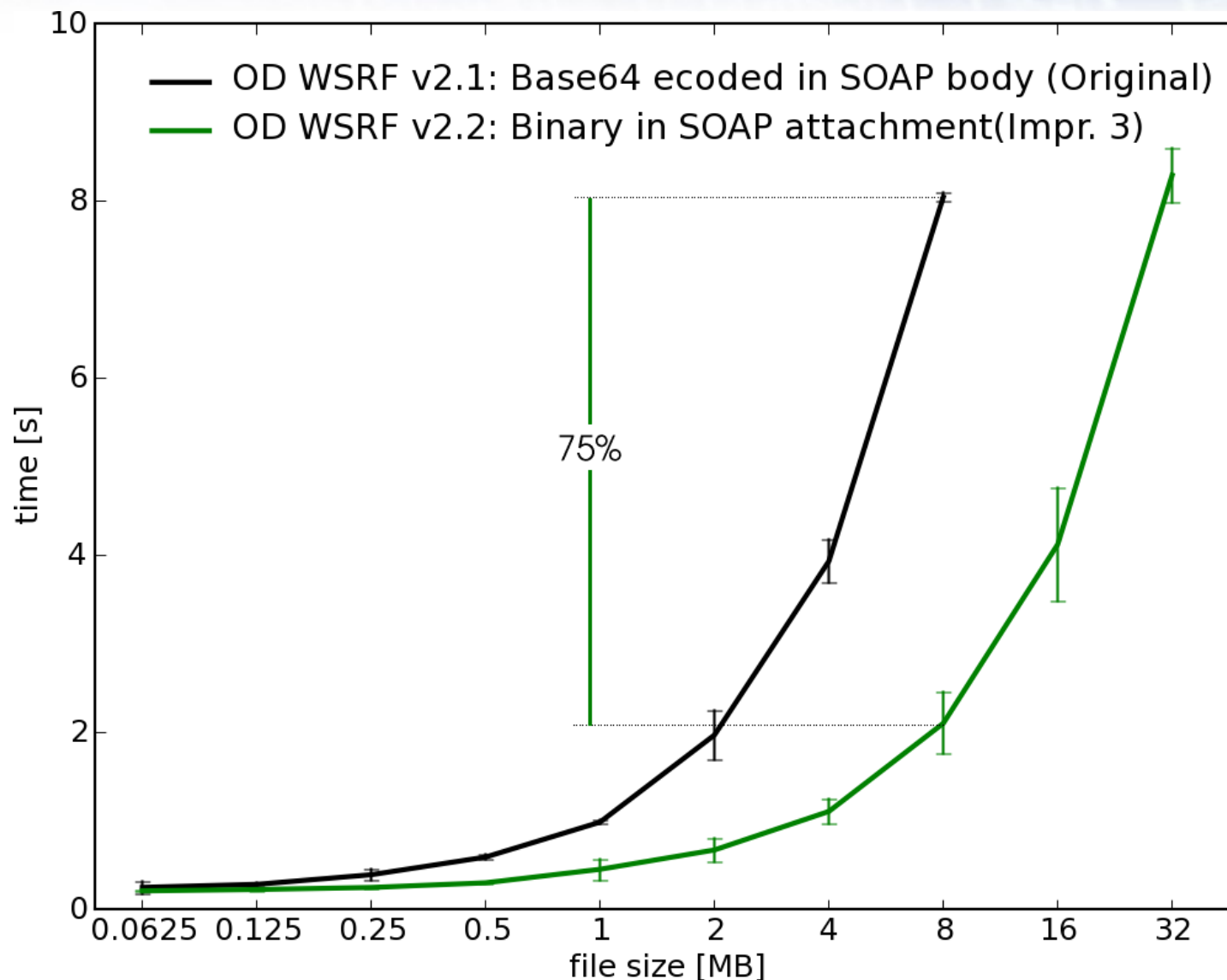
- Both concerns addressed by using SOAP messages with attachments
  - No special encoding needed for binary data attached to a SOAP message

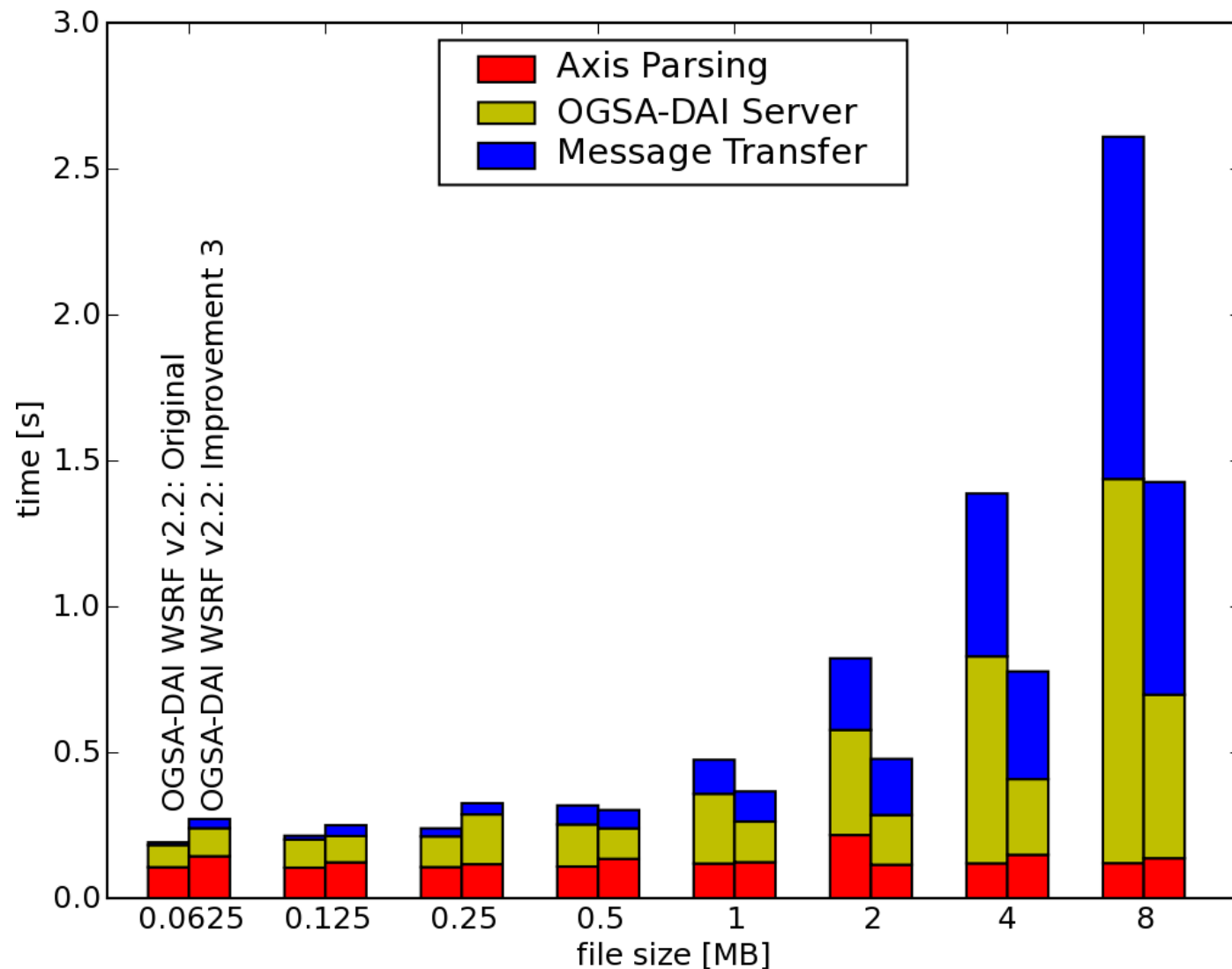
## **Drawback**

- SOAP messages with attachments is not a standard feature of all SOAP engines
- This may affect interoperability

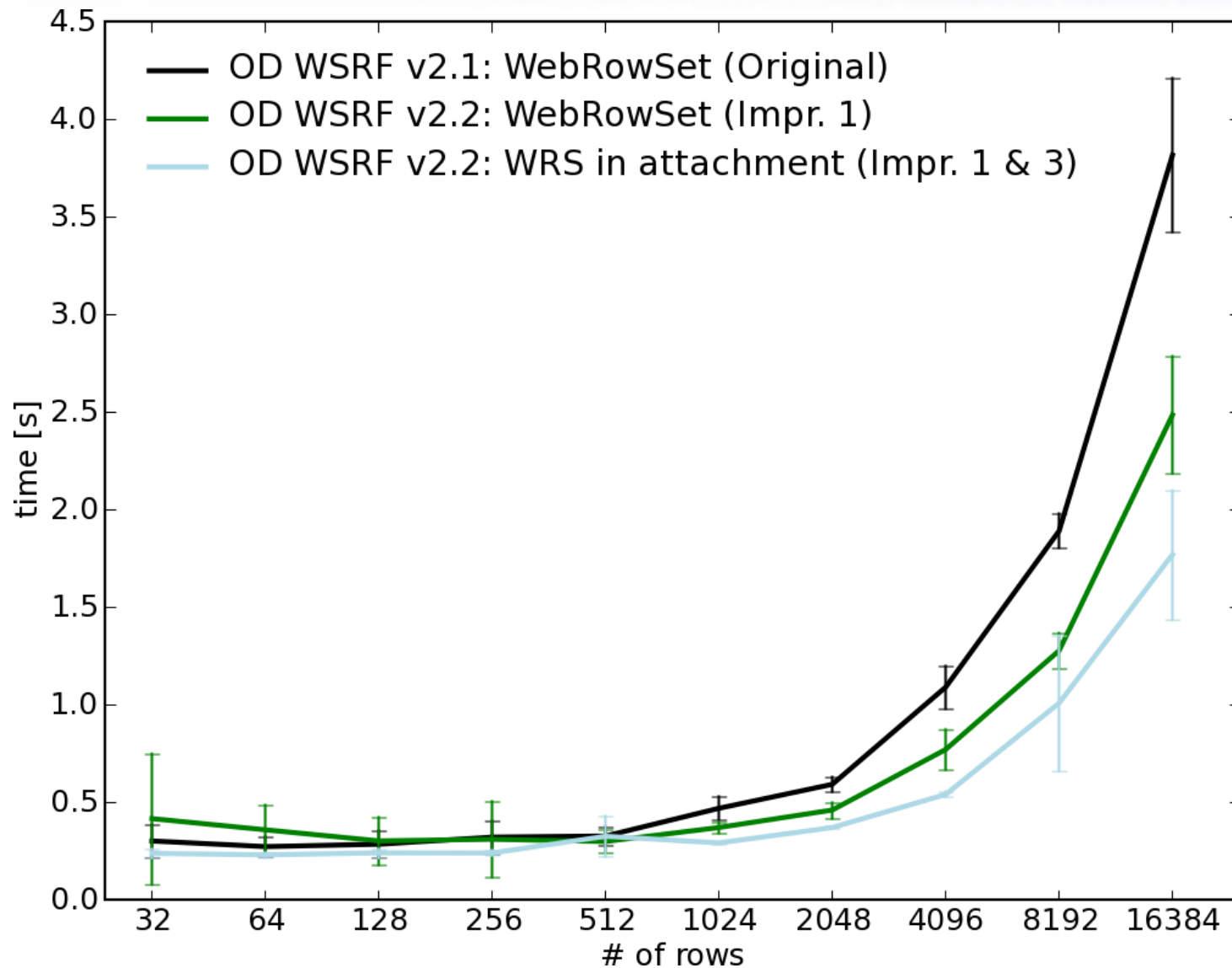




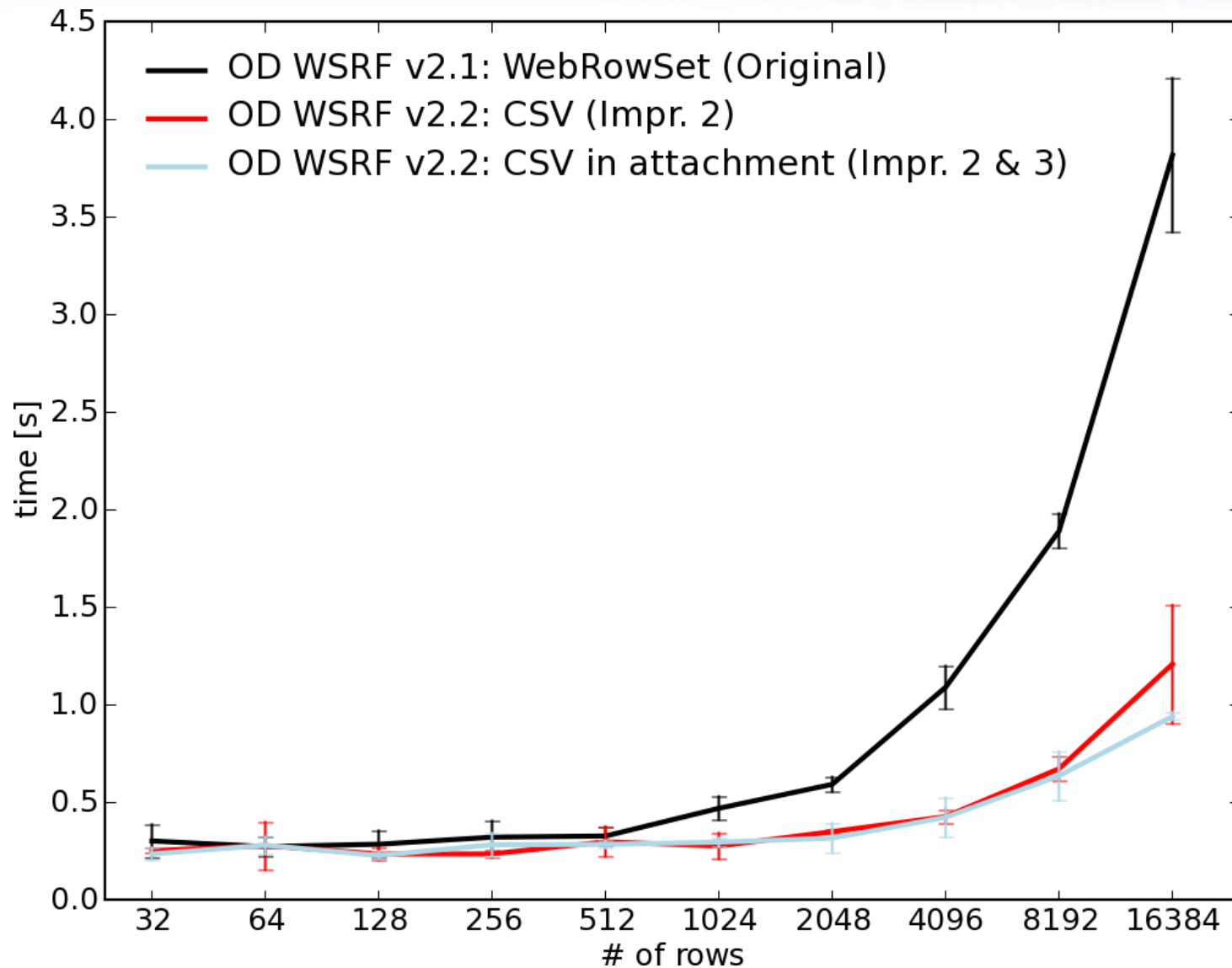




- Would expect to see additional improvement when delivering SQL Query results in attachments
  - SOAP message is smaller and easier to parse
- Last experiments tested if we gain performance when we
  - Transfer WebRowSet documents as SOAP attachments
  - Transfer CSV documents as SOAP attachments
- In these experiments we test combined impact of all introduced improvements







- Status summary of an ongoing process to improve the OGSA-DAI performance
- Have analysed two typical use patterns:
  - These were profiled
  - Results used to implement a set of performance improvements
- Benefit demonstrated by comparing the performance of:
  - Current OGSA-DAI release (WSRF 2.2)
  - Previous OGSA-DAI release (WSRF 2.1)
- For the SQL use case reduced execution time by 65% by:
  - Optimising conversion routines
  - Using CSV format instead of WebRowSet
- SOAP with attachments gave a 75% improvement (for 8MB)
  - Significant reduction in the time needed to deliver binary data

- Start by optimising conversion routines in your code
  - Especially if these are used often
- Profile your client and server code
  - Java profilers using Java Tool Interface (J2SE 5.0) are very powerful
  - Profiler manufactures often offer free licenses to open source projects
  - Results may surprise you!!
- Avoid using regular expressions for replacing characters
  - When called iteratively, accumulated cost may be significant
  - Writing dedicated parsers is usually easy and benefits are great
- Do not feel forced to use XML document formats
  - XML versatile but can be expensive in terms of space and processing
  - Use more lightweight formats when you do not need versatility
- Use SOAP with attachments to transfer binary data
  - And other large documents

## People Involved:

- Mario Antonioletti
- Ally Hume
- Jen Schopf
- The OGSA-DAI Team



- Author's email: [bartosz@epcc.ed.ac.uk](mailto:bartosz@epcc.ed.ac.uk)
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